CLAIMS

What is claimed is:

1. A method of fabricating a micromachined device by selectively bonding a plurality of layers of material, comprising:

a) providing a first layer of material;

b) providing a second layer of material;

c) providing a coating on a first portion of the first layer; and

d) bonding the first layer and the second layer to each other to form a micromachined device, the coating being effective to prevent the coated portion from bonding with the second layer.

2. The method defined in Claim 1 wherein the coating material is selected from the group consisting of silicon nitride, silicon carbide, polymer film, fluorocarbon film, and a silicon-ceramic material.

3. The method defined in Claim 1 wherein the coating material is silicon nitride.

4. The method defined in Claim 1 wherein the second layer has a plurality of mechanical parts formed in, the mechanical parts being movable relative to a stationary portion of the second layer.

5. The method defined in Claim 4 wherein, in step c), the coating is provided on the first layer at a position that corresponds to the position of the mechanical parts formed in the second layer, such that when the first layer is positioned adjacent the second layer, the coating portion is adjacent the mechanical parts.

6. The method defined in Claim 5 further comprising, following step d), the steps of:

e) providing a third layer of material;

f) providing a coating on a first portion of the third layer; and

g) bonding the third layer to the second layer, wherein the coating on the third layer is effective to prevent the coated portion from bonding with the second layer.

7. The method defined in Claim 6 wherein, in step f), the coating is provided on the third layer at a position that corresponds to the position of the mechanical parts formed on the second layer, such that when the third layer is positioned adjacent the second layer, the coating portion is adjacent the mechanical parts.

8. The method defined in Claim 1 further comprising, following step a), the step:

a1) thinning the first portion of the first layer to reduce the thickness thereof such that when the coating material is applied to the portion in step c), an upper surface of the coating is substantially flush with an adjacent upper surface of the first layer.

9. The method defined in Claim 1, in step d), wherein a fusion bonding process is used to bond the first layer to the second layer.

10. The method defined in Claim 1, wherein in step d), a direct bonding process is used to bond the first layer to the second layer.

11. The method defined in Claim 1 further comprising, prior to step c), a step:

c') masking a second portion of the first layer wherein the second portion comprises an area of the first layer that is not to be coated by the coating.

12. The method defined in Claim 1 wherein the coating is applied with a thickness of 10 Angstroms to 100 micrometers.

13. A method of producing a micromachined device by selectively bonding a plurality of layers of material, comprising:

a) providing a first layer of material;

b) providing a second layer of material;

c) providing a coating on a portion of at least one of the first layer and second layer; and

d) bonding the first layer and the second layer to each other to form a micromachined device, wherein bonding of the second layer and the first layer occurs only where the coating contacts both layers.

14. The method defined in Claim 13 wherein the second layer has a plurality of mechanical parts formed therein, the mechanical parts being movable relative to a stationary portion of the second layer.

15. The method defined in Claim 14 further comprising, before step c), a step:

c') masking the mechanical parts formed in the second layer such that the mechanical parts remain uncoated when the coating is provided in step c).

16. The method defined in Claim 14 wherein, during step c), only a selected portion of the first layer is coated such that a portion of the first layer remains uncoated, and further includes, prior to step d), step:

d') positioning the first layer and the second layer adjacent each other such that the uncoated portion of the first layer is positioned adjacent the mechanical parts of the second layer.

17. The method defined in Claim 14 further comprising, following step d), the steps of:

e) providing a third layer of material;

f) coating a selected portion of the third layer such that a portion of the third layer remains uncoated;

g) positioning the third layer and the second layer adjacent each other such that the uncoated portion of the third layer is positioned adjacent the mechanical parts of the second layer; and

h) bonding the third layer and the second layer to each other, wherein bonding of the second layer and the third layer occurs only where the coating contacts both layers.

18. The method defined in Claim 13 further comprising, following step a), the step:

a1) thinning the portion of the first layer to reduce the thickness thereof such that when the coating material is applied to the portion, in step c), an upper surface of the coating is substantially flush with an adjacent upper surface of the first layer.

19. The method defined in Claim 13 wherein the coating material is selected from the group consisting of silicon, silicon dioxide, glass, gold, silver, and solder material.

20. The method defined in Claim 13 wherein the coating is applied with a thickness of 10 Angstroms to 100 micrometers.

21. A method of forming a microvalve comprising:

a) providing a plurality of layers of material, including at least a first layer and a second layer, wherein at least the first layer includes a movable microvalve portion that is movable relative to a stationary portion of the first layer;

b) coating a portion of the second layer;

c) positioning the coated portion of the second layer adjacent to the movable microvalve portion of the first layer; and

d) performing a bonding operation to bond the plurality of layers together, wherein the coating prevents the movable microvalve portion of the first layer from bonding with the coated portion of the second layer while an uncoated portion of the second layer bonds to the stationary portion of the first layer.

22. The method defined in Claim 21 wherein the coating material is selected from the group consisting of silicon nitride, silicon carbide, polymer film, fluorocarbon film, and a silicon-ceramic material.

23. The method defined in Claim 21 wherein the coating material is silicon nitride.

24. The method defined in Claim 21 wherein the plurality of layers includes a third layer of material, and further comprising, following step d), the steps of:

e) providing a coating on a portion of the third layer; and

f) bonding the third layer to the first layer, wherein the coating on the third layer is effective to prevent the movable microvalve portion of the first layer from bonding with the coated portion of the third layer while an uncoated portion of the third layer bonds to the stationary portion of the first layer.

25. The method defined in Claim 24, during step e), wherein only a portion of the third layer is coated such that the coating is provided on the third layer at a position that corresponds to the position of the movable microvalve portion of the first layer and a portion of the third layer remains uncoated, and further including, after step e), the step:

e1) positioning the third layer adjacent the first layer such that the coating portion is adjacent the movable microvalve portion of the first layer.

26. The method defined in Claim 21 further comprising, following step a), the step:

a1) thinning the first portion of the second layer to reduce the thickness thereof such that when the coating material is applied to the portion in step b), an upper surface of the coating is substantially flush with an adjacent surface of the second layer.

27. The method defined in Claim 21 wherein, in step d), a fusion bonding process is used to bond the first layer to the second layer.

28. The method defined in Claim 21 wherein, in a step d), a direct bonding process is used to bond the first layer to the second layer.

29. The method defined in Claim 21 further comprising, before step b), a step:

b') masking a second portion of the second layer wherein the second portion comprises an area of the second layer that is not to be coated by the coating when the coating is applied to the rest of the second layer in step b).

30. The method defined in Claim 21 wherein the coating is applied with a thickness of 10 Angstroms to 100 micrometers.

31. A method of forming a microvalve comprising:

a) providing a plurality of layers of material, wherein at least the first layer includes a movable microvalve portion that is movable relative to a stationary portion of the first layer;

b) coating a portion of a second layer;

c) positioning the coated portion of the second layer adjacent to the stationary portion of the first layer; and

d) performing a bonding operation to bond the plurality of layers together, wherein the coating causes the stationary portion to bond with the coated portion of the second layer, while the uncoated portion of the second layer does not bond with the movable microvalve portion of the first layer.

32. A method of forming a micromachined device comprising:

a) providing a first silicon layer;

b) providing a second silicon layer;

c) etching a portion of the second silicon layer to form a portion of a micromachined device including a slider portion and a layer portion such that the slider portion is movable relative to the layer portion;

d) coating a portion of the first silicon layer with a coating material, the coated portion having a size and shape that corresponds to the size and shape of the slider portion;

e) positioning the first silicon layer over the second silicon layer such that the coated portion of the first silicon layer is substantially aligned with the slider portion of the second silicon layer; and

f) performing a bonding operation to bond the first silicon layer to the second silicon layer, wherein the coating material separates the slider portion from the first silicon layer during the bonding operation to prevent the slider portion from bonding with the first layer.

33. A method of forming a micromachined device comprising:

a) providing a first silicon layer;

b) providing a second silicon layer;

c) etching a portion of the second silicon layer to form a portion of a micromachined device including a slider portion and a layer portion wherein the slider portion is movable relative to the layer portion;

d) coating a portion of the first silicon layer with a coating material, the coating being placed in areas where bonding is desired, the coating materials being at least one of selectively masked to be prevented from coating areas over the slider portion and removed from areas over the slider portion in a subsequent step;

e) positioning the first silicon layer over the second silicon layer such that the uncoated portion of the first silicon layer is substantially aligned with the slider portion of the second silicon layer; and

f) performing a bonding operation to bond the first silicon layer to the second silicon layer only in areas where the coating is placed, wherein the uncoated areas separate the slider portion from the first silicon layer during the bonding operation to prevent the slider portion from bonding with the first layer.

34. The method defined in Claim 33 wherein the coating material is selected from the group consisting of silicon, silicon dioxide, glass, gold, silver, and solder material.

35. The method defined in Claim 33 wherein the coating is applied with a thickness of 10 Angstroms to 100 micrometers.

36. A method of selectively bonding a plurality of layers of material to form a micromachined device, comprising:

a) providing a first layer of material;

b) providing a second layer of material;

c) providing a coating on a portion of the first layer of material;

d) etching the first layer of material to form a portion of a micromachined device including a slider portion within the first layer and a layer portion, wherein the slider portion is movable relative to the layer portion, and the slider portion substantially corresponds to the size and shape of the coating portion; and

e) bonding the first layer and the second layer to each other, the coating being effective to prevent the portion from bonding with the second layer.

37. The method defined in Claim 36 wherein the coating material is selected from the group consisting of silicon nitride, silicon carbide, polymer film, fluorocarbon film, and a silicon-ceramic material.

38. The method defined in Claim 36 wherein the coating is applied with a thickness of 10 Angstroms to 100 micrometers.